CLAIMS

1. An adaptive transceiver device of a CDMA (Code Division Multiple Access) system characterized by comprising:

path search means for calculating path level information and path delay time information from antenna reception signals;

M (M is a positive integer) adaptive reception units for receiving N (N is a positive integer) antenna reception signals, forming reception directivity patterns each having a gain in the direction of a desired wave signal every path delay time, receiving the desired wave signals, and suppressing interference wave signals;

reception antenna weight selection means for selecting reception antenna weights for L (L is an integer equal to or smaller than M) transmission paths among the M reception antenna weights by using the path level information;

L transmission antenna weight control units for determining transmission antenna weights for forming transmission directivity patterns by using outputs from the reception antenna weight selection means; and

an adaptive transmission unit for forming the transmission directivity pattern having a gain in a user direction by using the transmission antenna weight which is an output from the transmission antenna weight control unit and outputting N combining antenna transmission signals for transmitting the desired wave signal.

2. The adaptive transceiver device according to claim 1, characterized in that the adaptive reception unit has: M delay means which receive the N antenna reception signals and the path delay time information which is an output from the path search means and which match timings depending on the path delay times of M multi-paths; M adaptive reception sub-blocks for forming the reception directivity patterns having gains in the directions of the M multi-paths, suppressing the interference wave signal, and receiving and demodulating the desired wave signal; an adder for synthesizing M demodulation signals; and decision means for performing hard decision to output a decision symbol.

3. The adaptive transceiver device according to claim 2, characterized in that the antenna reception signal is a code division multiple access (CDMA) signal, and

each of the M adaptive reception sub-blocks has: N despreading means which receive the N antenna reception signals and the decision symbol and performs despreading to each of the antenna reception signals by using a pseudo random code of the desired wave signal; a reception weighting combining unit for forming the reception directivity pattern; a demodulation unit for performing the transmission path estimation; a multiplier for multiplying the decision symbol by a complex transmission path estimation value which is an output from the demodulation unit to cancel a phase change caused by carrier wave phase synchronization; error detection means for subtracting each output from the despreading means

from an output from the multiplier; delay means for delaying outputs from the N despreading means depending on the process times of the reception weighting combining means, the demodulation means; and reception antenna weight control means for outputting the reception antenna weight on the basis of the minimum mean square error (MMSE) standards such that the average power of the reception antenna weight control error is minimized by using an output from the delay means and the reception antenna weight control error.

4. The adaptive transceiver device according to claim 3, characterized in that the reception weighting combining unit has: N complex multipliers which receive the N antenna reception signals and the reception antenna weights and which multiply the reception signals by N complex reception antenna weights; and an adder for synthesizing respective outputs from the N complex multipliers.

5. The adaptive transceiver device according to claim 3, characterized in that the demodulation means has: transmission path estimation means which receives an output from the weighting combining unit to estimate the amplitude and the phase of a carrier wave; complex conjugate operation means for calculating a complex conjugate of complex transmission path estimation values which are output from the transmission path estimation means; and a multiplier for multiplying an output from the complex conjugate operation means by an output from the despreading means to perform

carrier wave phase synchronization and, at the same time, to perform weighting for synthesizing a maximum ratio.

6. The adaptive transceiver device according to claim 4, characterized in that the demodulation means has: transmission path estimation means which receives an output from the weighting combining unit to estimate the amplitude and the phase of a carrier wave; complex conjugate operation means for calculating a complex conjugate of complex transmission path estimation values which are output from the transmission path estimation means; and a multiplier for multiplying an output from the complex conjugate operation means by an output from the despreading means to perform carrier wave phase synchronization and, at the same time, to perform weighting for synthesizing a maximum ratio.

7. The adaptive transceiver device according to claim 1, characterized in that the reception antenna weight selection means receives M reception antenna weights which are outputs from the M adaptive reception sub-blocks, path level information which is an output from the path search means, a path level threshold value, and a maximum transmission count Lmax, and selects a selection reception antenna weight corresponding to L paths the number of which is not larger than the maximum transmission count Lmax and which has a level set within the range of the level of the maximum path to the path level threshold value from the M reception antenna weights.

8. The adaptive transceiver device according to claim 1, characterized in that the transmission antenna weight control unit has: an arrival direction estimation unit which receives the selection reception antenna weight to estimate an estimated arrival direction from the selection reception antenna weight; and a transmission antenna weight generation means for calculating a transmission antenna weight for forming a directivity pattern having a gain in the estimated arrival direction which is an output from the arrival direction estimation unit.

9. The adaptive transceiver device according to claim 1, characterized in that the transmission antenna weight control unit has: an arrival direction estimation unit which receives the selection reception antenna weight to estimate an estimated arrival direction from the selection reception antenna weight; transmission direction prediction means for predicting a transmission direction on the basis of the estimated arrival direction which is an output from the arrival direction estimation unit; and transmission antenna weight generation means for calculating a transmission antenna weight for forming a directivity pattern having a gain in the prediction transmission direction which is an output from the transmission direction prediction means.

10. The adaptive transceiver device according to claim 2, characterized in that the reception antenna weight selection means receives M reception antenna weights which are outputs from the M adaptive reception sub-blocks, path level

information which is an output from the path search means, a path level threshold value, and a maximum transmission count Lmax, and selects a selection reception antenna weight corresponding to L paths the number of which is not larger than the maximum transmission count Lmax and which has a level set within the range of the level of the maximum path to the path level threshold value from the M reception antenna weights.

11. The adaptive transceiver device according to claim 2, characterized in that the transmission antenna weight control unit has: an arrival direction estimation unit which receives the selection reception antenna weight to estimate an estimated arrival direction from the selection reception antenna weight; and transmission antenna weight generation means for calculating a transmission antenna weight for forming a directivity pattern having a gain in the estimated arrival direction which is an output from the arrival direction estimation unit.

12. The adaptive transceiver device according to claim 2, characterized in that the transmission antenna weight control unit has: an arrival direction estimation unit which receives the selection reception antenna weight to estimate an estimated arrival direction from the selection reception antenna weight; transmission direction prediction means for predicting a transmission direction on the basis of the estimated arrival direction which is an output from the arrival direction estimation unit; and transmission antenna weight

generation means for calculating a transmission antenna weight for forming a directivity pattern having a gain in the prediction transmission direction which is an output from the transmission direction prediction means.

13. The adaptive transceiver device according to claim 11, characterized in that the arrival direction estimation unit has: arrival direction generation means which receives the selection reception antenna weight to sweep arrival directions over all the directions; steering vector generation means for calculating an antenna weight for forming a directivity pattern of a maximum antenna gain in the arrival direction; correlative calculation means for calculating a correlation between the selection reception antenna weight and an antenna weight which is an output from the steering vector generation means; maximum value detection means for detecting the maximum value of outputs from the correlative calculation means with respect to all the arrival directions; and switching means for outputting the arrival direction at a point of time at which the maximum value is detected as an estimated arrival direction.

14. The adaptive transceiver device according to claim 12, characterized in that the transmission direction prediction means predicts a present arrival direction by using a past arrival direction which is estimated late because of the control of the adaptive reception unit.

15. The adaptive transceiver device according to claim 1, characterized in that the adaptive transmission unit has: L adaptive transmission sub-blocks which receive L transmission

antenna weights which are outputs from the L transmission antenna weight control units and a transmission signal and which output N antenna transmission signals for forming a directivity pattern having a gain in a user direction on the basis of the transmission antenna weights and transmitting a desired wave signal; and N adders for synthesizing the antenna transmission signals every antenna to output N combining antenna signals.

16. The adaptive transceiver device according to claim 2, characterized in that the adaptive transmission unit has: L adaptive transmission sub-blocks which receive L transmission antenna weights which are outputs from the L transmission antenna weight control units and a transmission signal and which output N antenna transmission signals for forming a directivity pattern having a gain in a user direction on the basis of the transmission antenna weights and transmitting a desired wave signal; and N adders for synthesizing the antenna transmission signals every antenna to output N combining antenna signals.

17. The adaptive transceiver device according to claim 15, characterized in that each of the adaptive transmission sub-blocks has: a transmission weighting combining unit which receives the transmission antenna weight and the transmission signal to form a transmission directivity pattern; and N spreading means for performing spectrum spreading to each of the N antenna transmission signals by using a pseudo random code of a desired wave signal.

18. The adaptive transceiver device according to claim 17, characterized in that the reception antenna weight is updated every symbol, and the step of updating the reception antenna weight is determined depending on the degree of convergence of the reception antenna weight.

19. The adaptive transceiver device according to claim 18, characterized in that the transmission weighting combining unit has N complex multipliers which receive the transmission antenna weight and the transmission signal and which multiply the transmission signal by N complex transmission antenna weights.